

Claims

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1. A controller comprising a base, a platform, means for mounting said platform for a range of movement in a plane in each of two different directions, a first magnetic force applying means including a first magnet means mounted on said base and a first cooperating magnetic force generating means mounted on and moveable with said platform in position to interact with said first magnet means, a second magnetic force applying means including a second magnet means mounted on said base and a second cooperating magnetic force generating means mounted on and moveable with said platform in a position to interact with said second magnet means, said first force applying means being positioned and constructed to controllably apply selected forces to said platform in one of said two different directions and said second force applying means being constructed and positioned to controllably apply selected forces to said platform in the other of said two different directions and control means to selectively control said first and said second force applying means to generate said selected forces.
 2. A controller as defined in claim 1 wherein said two directions are mutually perpendicular.
 3. A controller as defined in claim 1 further comprising a sensor means for sensing the position of said platform relative to said base.
 4. A controller as defined in claim 3 wherein said sensor means comprises a transparent grid mounted on and moveable with said platform and a light source and a detector means fixed relative to said base in positions wherein light from said source passes through said grid and is detected by said detector means.
 5. A controller as defined in claim 2 further comprising a sensor means for sensing the position of said platform relative to said base.
 6. A controller as defined in claim 5 wherein said sensor means comprises a transparent grid mounted on and moveable with said platform and a light source and a detector means fixed relative to said base in positions wherein light from said source passes through said grid and is detected by said detector means.
 7. A controller as defined in claim 2 wherein said first cooperating

magnet force generating means including a first coil means position to interact with said first magnet means when a current is applied to said first coil means, and said second magnetic force generating means including a second cooperating coil means in a position to interact with said second magnet means when a current is applied to said second coil means, said first magnet means and said first cooperating coil means of said first force applying means being shaped and positioned so that in any position of said platform within said range said coil may be controlled to apply said selected forces between each of said first and second cooperating coil means and its respective magnet means and wherein said control means selectively applies current to said first and said second cooperating coil means to generate said selected forces.

8. A controller as defined in claim 7 wherein the projected area of a field generated by said first magnet means onto said first cooperating coil means is substantially constant so that the application of a selected current to said first cooperating coil means generates the same force between said first magnet means and said first cooperating coil means regardless of the position of said platform within said range of movement, said second magnet means and said second cooperating coil means of said second force applying means being shaped and positioned so that in any position of said platform within said range the projected area of a field generated by said second magnet means onto said second cooperating coil means is substantially constant so that the application of a selected current to said second cooperating coil means generates the same force between said second magnet means and said second cooperating coil means regardless of the position of said platform within said range.

9. A controller as defined in claim 8 wherein said first cooperating coil means comprises a first elongated substantially planar coil having its major axis extending substantially parallel to said plane and to one of said pair of mutually perpendicular directions and said second cooperating coil means comprises a second elongated substantially planar coil having its major axis substantially parallel to said plane and said other of said mutually perpendicular directions.

10. A controller as defined in claim 5 wherein said first cooperating

magnet force generating means including a first coil means position to interact with said first magnet means when a current is applied to said first coil means, and said second magnetic force generating means including a second cooperating coil means in a position to interact with said second magnet means when a current is applied to said second coil means, said first magnet means and said first cooperating coil means of said first force applying means being shaped and positioned so that in any position of said platform within said range said coil may be controlled to apply said selected forces between each of said first and second cooperating coil means and its respective magnet means and wherein said control means selectively applies current to said first and said second cooperating coil means to generate said selected forces.

11. A controller as defined in claim 10 wherein the projected area of a field generated by said first magnet means onto said first cooperating coil means is substantially constant so that the application of a selected current to said first cooperating coil means generates the same force between said first magnet means and said first cooperating coil means regardless of the position of said platform within said range of movement, said second magnet means and said second cooperating coil means of said second force applying means being shaped and positioned so that in any position of said platform within said range the projected area of a field generated by said second magnet means onto said second cooperating coil means is substantially constant so that the application of a selected current to said second cooperating coil means generates the same force between said second magnet means and said second cooperating coil means regardless of the position of said platform within said range.

12. A controller as defined in claim 11 wherein said first cooperating coil means comprises a first elongated substantially planar coil having its major axis extending substantially parallel to said plane and to one of said pair of mutually perpendicular directions and said second cooperating coil means comprises a second elongated substantially planar coil having its major axis substantially parallel to said plane and said other of said mutually perpendicular directions.

13. A controller as defined in claim 6 wherein said first cooperating

magnet force generating means including a first coil means position to interact with said first magnet means when a current is applied to said first coil means, and said second magnetic force generating means including a second cooperating coil means in a position to interact with said second magnet means when a current is applied to said second coil means, said first magnet means and said first cooperating coil means of said first force applying means being shaped and positioned so that in any position of said platform within said range said coil may be controlled to apply said selected forces between each of said first and second cooperating coil means and its respective magnet means and wherein said control means selectively applies current to said first and said second cooperating coil means to generate said selected forces.

14. A controller as defined in claim 13 wherein the projected area of a field generated by said first magnet means onto said first cooperating coil means is substantially constant so that the application of a selected current to said first cooperating coil means generates the same force between said first magnet means and said first cooperating coil means regardless of the position of said platform within said range of movement, said second magnet means and said second cooperating coil means of said second force applying means being shaped and positioned so that in any position of said platform within said range the projected area of a field generated by said second magnet means onto said second cooperating coil means is substantially constant so that the application of a selected current to said second cooperating coil means generates the same force between said second magnet means and said second cooperating coil means regardless of the position of said platform within said range.

15. A controller as defined in claim 14 wherein said first cooperating coil means comprises a first elongated substantially planar coil having its major axis extending substantially parallel to said plane and to one of said pair of mutually perpendicular directions and said second cooperating coil means comprises a second elongated substantially planar coil having its major axis substantially parallel to said plane and said other of said mutually perpendicular directions.

16. A controller as defined in claim 9 wherein said first magnet means and

said second magnet means each comprises a pair of permanent magnet means, one permanent magnet means of each said pair located on one side of its said cooperating coil means and the other permanent magnet means of each said pair of permanent magnet means located on the side of its said cooperating coil means opposite its respective said one permanent magnet means.

17. A controller as defined in claim 16 wherein each said permanent magnet means comprises a pair of permanent magnets arranged in spaced parallel relationship with their magnetic poles facing in opposite directions and with their polar axes substantially parallel to the plane of said planar coils.

18. A controller as defined in claim 17 wherein said polar axis of each said permanent magnet means is substantially parallel to said major axis of its respective cooperating planar coil.